6: Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.
The toxicity and pesticide water quality objectives that apply to diazinon and chlorpyrifos include provisions for considering additive or synergistic effects. The Amendment is based on the current understanding of the additive effects of diazinon and chlorpyrifos. Diazinon and chlorpyrifos may also have additive or synergistic effects in combination with other pollutants. To determine if such effects are occurring, monitoring for toxicity, and monitoring other pollutants suspected of acting in an additive or synergistic manner with diazinon and chlorpyrifos, will be required. Such monitoring can be conducted in conjunction with monitoring for diazinon and chlorpyrifos.

7: Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.
Goal 7 can be met by assessing the information collected to meet goals 3 and 4. Evaluation of the effectiveness of management practices should help identify which ones (or combinations) produce the lowest pesticide levels in discharge and are economically achievable. Tracking the degree of implementation of these practices should help the Regional Board determine whether the practices are wide spread enough to achieve the lowest pesticide levels possible in the San Joaquin River.

5 Economic Analysis, Estimated Costs, and Potential Sources of Financing

The Porter-Cologne Water Quality Control Act requires that, "prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan." It also requires a consideration of economics when water quality objectives are established. This section presents the information needed to meet these requirements.

5.1 Estimated Costs to Dischargers

There are two pesticides and two seasons of use that are addressed by this Basin Plan Amendment. Since stormwater runoff appears to be the primary pesticide transport mechanism during the dormant season, and irrigation runoff is the primary transport mechanism during the growing season, different practices to reduce pesticide runoff will be needed, depending on the season of use. It is assumed for purposes of this economic analysis that dormant season practices to reduce pesticide runoff will primarily be pest control practices and passive runoff control (e.g. buffer strips) since management of large volumes of stormwater runoff may be impractical. For the growing season, it is assumed that practices to reduce pesticides in irrigation runoff will include pest management practices and irrigation water management practices, since management of irrigation runoff is feasible for all growers. The following subsections describe the estimated costs for dormant season pest management and passive runoff management, irrigation season pest management, and irrigation season water management.

5.1.1 Dormant Season Pest Management Costs

Meeting the water quality objectives for diazinon and chlorpyrifos in the San Joaquin River (SJR) system will require changes in pest management practices to reduce diazinon and chlorpyrifos in stormwater runoff. In the SJR watershed, approximately 85% of the diazinon and chlorpyrifos used during the dormant season (December through February) is applied to almond, peach, and apple orchards (CDPR Pesticide Use Report). Consequently, this section focuses on pest management and cultural practices considered to be effective in controlling target pests on these crops, and reducing diazinon and chlorpyrifos runoff from these crops. Costs are likely to be similar for other orchard crops where these pesticides are used to a lesser extent, such as prunes, apricots and walnuts.

Dormant Season Pest Management Scenarios

Economic analyses are provided for dormant season use of diazinon and chlorpyrifos on almonds, peaches and apples. For each crop, five scenarios are described, each comprised of a suite of possible pest management practices and cultural practices. Cultural practices are defined as including the costs of fertilizers, irrigation, and pesticides, plus harvesting costs, cash overhead, interest on capital, and advisory board assessments. Total costs per acre include fertilizers, irrigation, and pesticides, plus harvesting costs, cash overhead, interest on capital, and advisory board assessments (when applicable). Gross revenue per acre is the commodity price per ton multiplied by the tons produced per acre. Returns to Land, Management, and Overhead equals the gross revenue per acre, minus the total costs per acre. Data for all costs except dormant sprays are from University of California Cooperative Extension cost analyses (UCCE 1998; 2001; 2002a,b; 2003). Data for dormant spray costs are from Zalom et. al. (1999). The UCCE cost analysis for cling peaches was published in 1998 (UCCE, 1998), and cost data were adjusted for inflation by adding 3%. Revenue data and advisory board assessments are for 2003 (CITE) and were not adjusted. Revenue data are for 2003 (Ferriera, B. pers. comm.) and were not adjusted.

Costs for the dormant season alternate scenarios included hypothetical costs for in-season applications that could be needed to control pests during the growing season. The hypothetical likelihood of these in-season applications being necessary varies according to the crop and the scenario. For peaches and almonds, this likelihood is based on PUR data for diazinon and chlorpyrifos. It was assumed that the base case (dormant oil with OP pesticide) is the most effective approach, i.e. will effectively control pests during the dormant season, and if used then in-season sprays will be least likely to be necessary. All other approaches (except pyrethroids) will be less effective at controlling pests in the dormant season and will result in a higher likelihood of in-season sprays being needed. Ratios for all other alternate scenarios in peaches and almonds, except pyrethroids, were then set equal to or greater than this PUR ratio.

For pyrethroids on peaches and almonds, the probabilities of needing in-season applications were set higher than for diazinon and chlorpyrifos because pyrethroids persist longer and kill beneficial insects, which causes an upsurge in harmful insect and mite populations, necessitating in-season sprays. For all alternate dormant season scenarios in apples, the likelihood of in-season applications being necessary was set at 1.0 (100%) because of the need for in-season applications to control codling moth. These applications are independent of dormant season treatments.

The complete scenarios are provided in Appendix D.

One of these scenarios, the Base Case, has caused water quality impairment in the San Joaquin River system. The other four are alternate scenarios that offer varying levels of water quality protection. These four scenarios present options for the use of several low risk pesticides (Alternate Scenarios 1, 2, 3) and one option for all orchards using higher-risk pesticides along with runoff mitigation (Alternate Scenario 4). In reality, other variations and combinations of these practices are, or may be, used for effective pest management and water quality protection. Although it is not possible to present all of the possible variations, the scenarios present typical combinations of practices, and costs for alternate pesticides are presented in this text and in Appendix D. Because some growers are already implementing lower risk pest management practices, this analysis presents a worst-case economic scenario, because it assumes that all growers would have to switch to lower risk practices.

The pest management and cultural practices discussed here are all considered "viable", that is, they offer favorable levels of pest control efficacy when compared to the base case. (Zalom et al, 1999) Most of these pest management and cultural practices have been recommended, or studied, by the University of California Integrated Pest Management Program (UCIPM), and are considered to be effective both for controlling pest damage and for reducing diazinon and chlorpyrifos runoff from orchards. The individual pest management practices and their costs are from a study conducted by the Statewide UCIPM Project, the Water Resources Center, and the Ecotoxicology Program at UC Davis (Zalom, et al. 1999), funded by the California State Water Resources Control Board (SWRCB). Each scenario is comprised of several specific practices. Specific practices for each scenario, such as choice of pesticide used, may vary depending on pest pressure and cultural and pest management practices used previously. Practices can also vary by crop and by year.

The cost of the pesticides typically applied with dormant oil represents less than 1% of the total production costs, so substitution of one pesticide for another has little effect on costs overall. If multiple applications are required, as for B*t*, or if one type of pesticide increases the need for additional applications, as with pyrethroids, because pyrethroids persist longer and kill beneficial insects, which causes an upsurge in harmful insect and mite populations, necessitating in-season sprays and increased costs. Costs increase accordingly because each additional pass over the field generates new costs.

The probabilities for needing in-season treatments for a given scenario were determined from an analysis of DPR's Pesticide Use Reports (PUR). It is difficult to predict how much the lack of a dormant insecticide will result in the need for additional in-season sprays because pest populations are highly variable from year to year.

This economic analysis identifies the total costs of the base case and the alternate scenarios. The total cost of the base case is compared to the total cost of the alternate scenarios. Costs are compared for each crop and are expressed as an absolute change and a percent change in total costs, relative to the base case.

Economic Analysis of Base Case: All Growers Use Dormant Oil with Diazinon or Chlorpyrifos
The current pest management practice of treating orchards with dormant oil (DO) and diazinon or chlorpyrifos is generally very effective in controlling peach twig borer (PTB), San Jose scale

(SJS), aphids, and mites, and greatly reduces the need for in-season applications of other pesticides to control these pests.

Total annual costs per acre for the base case for almonds, peaches and apples are $2,749, $3,951, and $11,692, respectively when diazinon is used, and $2,735, $3,917, $11,688, respectively when chlorpyrifos is used (see Appendix X). These costs assume that either diazinon or chlorpyrifos is used for the dormant season application. The probability of needing an in-season application was based upon CDPR Pesticide Use Report data (2000-2002) when possible. Probabilities for dormant oil alone, dormant oil plus *Bt* and dormant oil plus spinosad on almond and peach could not be obtained from PUR data. No probabilities could be obtained for apple from PUR data. Probabilities for these scenarios were estimated. Other commonly-used organophosphates (OP) such as Guthion® (azinphos-methyl) and Supracide® (methidathion) are more expensive than diazinon or chlorpyrifos, but would probably be used only if the orchard had a history of scale problems.

Costs would be higher if in-season pesticide applications were needed to control aphids, mites, scale, or other pest problems. In-season applications are generally not necessary in almonds if an OP insecticide is applied during the dormant season, but are somewhat more likely to be needed in peaches.

Base case Total Costs as a Percent of Gross Revenue for almonds, peaches and apples are 110%, 84%, and 76 %, respectively when diazinon is used, and 109%, 83% and 76%, respectively when chlorpyrifos is used. This percentage does vary, depending primarily on crop price. Increased interest rates, advisory board assessments, harvest costs, and other factors would also cause these percentages to change.

Economic Analysis of Alternate Scenario 1: All Growers Use Pest Management Materials that Pose Little or No Risk to Water Quality – Dormant Oil Only

In Scenario 1 all growers use dormant oils without OPs, pyrethroids, or carbamates in the winter.

Total costs for this scenario for almonds, peaches and apples are $2,750, $3,937, and $11,673, respectively (Appendix D). Costs vary because of different susceptibilities to pests not controlled by dormant oil alone. This analysis has used estimated probabilities of 0.80, 1 and 0.80 for almonds, peaches and apples, respectively, to describe the potential need to make in-season applications of Imidan. These probabilities represent relative risks for each crop, and would vary greatly depending on orchard location, weather, variety grown, and many other factors. The cost of the Imidan applications has been multiplied by the specific probability for the crop and added to the cultural cost. No other costs have been added to account for any potential need for any other in-season applications. These cultural costs do not account for the potential risk of pest damage that would lower crop yield or price. These considerations also apply to Scenarios 2 and 3.

Percent change in cost from the Base Case for Scenario 1 for almonds, peaches and apples are 1%, 0%, and 0.1%, respectively. This percentage would vary according to the factors described above for the Base Case.

Economic Analysis of Alternate Scenario 2: All Growers Use Pest Management Materials that Pose Little or No Risk to Water Quality – Dormant Oil + Bt at Bloom
In Scenario 2, all growers use dormant oils without OPs, pyrethroids, or carbamates in the winter, with two bloom time applications of *Bt* for PTB. Scale, aphids, mites, and other pests would be controlled with in-season applications of pesticides such as Imidan, as needed.

Total costs for Scenario 2 for almonds, peaches and apples are $2,778, $4,000, and $11,741, respectively (Appendix D). Estimated probabilities of 0.65, 0.9, and 0.50 for almonds, peaches and apples, respectively, were assigned to describe the potential need to make in-season applications of Imidan.

Percent change in cost from the Base Case for Scenario 2 for almonds, peaches, and apples are 2%, 1% and 0%, respectively. This percentage would vary according to the factors described for the Base Case.

Economic Analysis of Alternate Scenario 3: All Growers Use Pest Management Materials that Pose Little or No Risk to Water Quality – Dormant Oil + Spinosad (Success®)
In Scenario 3, all growers use dormant oils without OPs, pyrethroids, or carbamates in the winter, with spinosad (Success®) added to dormant oil for control of PTB.

Total costs for Scenario 3 in almonds, peaches and apples are $2,740, $3,962, and $11,678, respectively, and probabilities of needing in-season treatments are 0.20, 0.9, and 0.50 (Appendix D). Percent change in cost from the Base Case for Scenario 3 for almonds, peaches and apples are 1%, 1%, and 0%, respectively.

Economic Analysis of Alternate Scenario 4: No Growers Use Pest Management Materials that Pose Little or No Risk to Water Quality. All Growers Use Dormant Oil + Pyrethroid. Use In Season Treatment As Needed. Use Cover Crops as Runoff Mitigation.
In Scenario 4, growers would use DO with pyrethroids plus in-season pesticides, as needed, and would establish cover crops to reduce runoff. Because pyrethroids are more persistent than OPs, and have more impacts on predators that help control pest populations, in-season applications may be necessary. Since the use of pyrethroids is likely to greatly reduce populations of beneficial insects, cover crops would be used to intercept runoff rather than harbor beneficial insects.

Total Costs for Scenario 4 for almonds range from $2,898 to $2,909, depending on the in-season treatment used. These costs for peaches and apples are $4,078 and $11,832 respectively (Appendix D). Percent change in cost from the Base Case for Scenario 4 for almonds, peaches and apples are 6%, 3%, and 1%, respectively.

A summary of the information described above is provided in Table 5.1.

Table 5.1 Summary of Differences in Dormant Season Pest Management Costs

	Almond		Peach		Apple	
	Total cost ($)	Percent Change from Base Case	Total cost ($)	Percent Change from Base Case	Total cost ($)	Percent Change from Base Case
Base Case (diazinon)	$2,749	NA	$3,951	NA	$11,692	NA
Base Case (chlorpyrifos)	$2,735	NA	$3,917	NA	$11,688	NA
Scenario 1	$2,750	1%	$3,937	0%	$11,673	0%
Scenario 2	$2,778	2%	$4,000	1%	$11,741	0%
Scenario 3	$2,760	1%	$3,962	1%	$11,703	0%
Scenario 4	$2,898- $2909	6%	$4,078	3%	$11,832	1%
Percent change from Base Case		1% to 6%		0% to 3%		0% to 1%

5.1.2 Economic Analysis Performed by USEPA

USEPA performed an economic analysis of alternatives to annual dormant season use of diazinon on almonds in California (USEPA. 2002.). The alternatives used in their analysis were: substitution with another OP pesticide (chlorpyrifos); alternate year application of diazinon; and use of a non-OP pesticide such as *Bacillus thurengensis*. The estimated cost increases for these alternatives were less than 1% (for substitution with chlorpyrifos), and from 2-6% for alternate year diazinon application or use of a non-OP alternative, depending on the level of pest pressure. This range of cost increases is similar to that estimated in this economic analysis for almonds.

5.1.3 Irrigation Season Pest Management Practices

Meeting the water quality objectives for diazinon and chlorpyrifos in the SJR during the irrigation season will require changes to pest management practices. Such changes may promote the reduced use of OP pesticides, or alternative pesticides that have a high likelihood of causing aquatic toxicity. These changes should reduce or eliminate the movement of pesticides from irrigated farmland to surface water.

For at least the last ten years, the use of diazinon (in pounds a. i.) during the irrigation season has been much less than the use of chlorpyrifos. For example, in 2002, 9416 pounds of diazinon (a.i.) were used, compared to 121,984 pounds of chlorpyrifos (a.i.). The use of both diazinon and chlorpyrifos has been declining for the last ten years (see Tables X and Y). Recent irrigation season use of chlorpyrifos has been primarily on alfalfa, almond, and walnut crops. These crops accounted for approximately 80% of the irrigation season use of chlorpyrifos in 2002, with alfalfa alone accounting for approximately one-half of the use. Diazinon was used primarily on cantaloupe, melon and prune crops during the 2002 irrigation season.

Alfalfa

Alfalfa is a perennial crop, and stands generally last from four to five years. Alfalfa weevil and the Egyptian weevil are the major economic insect pests of alfalfa. Other pests include aphids, army worms, cutworms and mites. Beneficial insects can be successful in controlling most of these pests, but they are not generally effective in controlling the Egyptian alfalfa weevil. Chlopyrifos has been used to control the Egyptian weevil.

Phosmet, malathion, dimethoate, carbofuran and pyrethroids are also used instead of chlorpyrifos. Pyrethroids in particular are increasingly being substituted for chlorpyrifos. Pyrethroids have been suggested as a potential alternative to chlorpyrifos because they are less likely to cause water quality impacts (Long et. al. 2002), and because pyrethroids appear to be more effective than chlorpyrifos in controlling Egyptian weevils (Putnam, pers. comm.). Pyrethroids are highly toxic to fish and they can also reduce populations of beneficial insects.

Long et al. (2002) suggested that the use of the pyrethroids lambda-cyhalothrin and cyfluthrin instead of chlorpyrifos may be a viable option for protecting water quality from runoff from alfalfa fields. The authors stated that the following factors appear to be responsible for this protection:

- Pyrethroids are highly hydrophobic and they also bind tightly to sediment and other organic material
- Alfalfa traps sediment due to its deep roots and vigorous canopy. It reduces soil movement during irrigation.

In this study, there was near zero mortality to *Ceriodaphnia dubia* in a 24-hour toxicity test. Alfalfa did appear to reduce the movement of sediment off the field. This study was based upon the state of knowledge available at the time, however, based upon current knowledge, additional information would be helpful. The pyrethroids used in this study (lambda-cyhalothrin and cyfluthrin) are also highly toxic to fish, and fish toxicity tests were not performed in this study. Pyrethroids in runoff samples were not detected at concentrations greater than the 0.05 parts per billion (ppb) detection limit; however, these pyrethroids are toxic (based on data from both invertebrates and fish) at concentrations of 0.002 ppb for cyfluthrin and 0.010 ppb for lambda-cyhalothrin (Solomon et. al. 2001). Lower detection limits may not have been available at the time of the Long study. Since pyrethroids bind tightly to sediment, it is more likely to detect them in sediment than in water samples.

Another pyrethroid study (Weston et. al. 2004) tested sediment samples collected from 42 locations throughout the Central Valley, with about 20 sites in this TMDL project area. Pyrethroids were detected in 75% of the samples, at a detection limit of 0.001 ppb. This study found that pyrethroid concentrations in samples collected from creeks, rivers and irrigation canals were high enough to have contributed to the observed toxicity in 40% of the samples that were toxic to *Chironomus tentans* and nearly 70% of the samples that were toxic to *Hyalella azteca.* Weston et. al. also noted information on pyrethroid toxicity from the previously cited study (Solomon et. al. 2001). This study plotted all water toxicity data for a wide variety of pesticides and concluded that the 10^{th} percentile of the toxicity distribution would be a convenient toxicity criterion. The 10th percentiles of the LC_{50} 's for pyrethroids in Weston et. al.

ranged from 0.010 to 0.180 ppb. Pistachios, almonds, peaches, alfalfa, lettuce and cotton were the major crops on which pyrethroids were used (from PUR 2000) that are grown in the vicinity of the Weston sampling sites.

The results of these two studies indicate that although alfalfa appears to trap sediment, and may possibly also trap the pyrethroids that are bound to the sediment, pyrethroids are still moving off areas where they are used, whether on alfalfa or on other crops. Additional management measures, primarily improved water management, will be needed to ensure that aquatic toxicity due to pyrethroids does not become an increasing issue in the future.

5.1.4 Irrigation Season Water Management Costs

Meeting the water quality objectives for diazinon and chlorpyrifos in the SJR during the irrigation season will require changes to water management practices. These changes will need to limit the amount of water that leaves the orchard or field, thereby reducing or eliminating the movement of pesticides from irrigated farmland to surface water.

Irrigation is a vital component of SJR agriculture. With little to no rainfall during the spring and summer months, the application of irrigation water is necessary to grow crops. During the irrigation season, pesticides are discharged to the SJR from agricultural drainage as a result of irrigation. Because irrigation practices are the primary means for pesticide movement into the SJR during the growing season, proper irrigation and drainage methods must be used. These methods focus on increasing irrigation efficiency to reduce excessive irrigation water volumes entering a field, thereby reducing the volume of pesticide-laden drainage water leaving the field. They also focus on managing drainage water to prevent pesticides from reaching the river.

This section of the economic analysis will focus on the costs to dischargers of irrigation practices that improve irrigation efficiency, as well as drainage practices that manage drainage water to prevent pesticides from reaching surface waters.

Irrigation Practices

Irrigation practices control the amount of water applied to a field. Efficient irrigation practices can help to reduce or eliminate the discharge of pesticides through irrigation water to surface waters. Irrigation practices can be broken down into three major categories: surface, sprinkler, and micro-irrigation. These practices are briefly described in the following sections. Additional information about their capabilities and limitations can be found in Burt (2000). Soil moisture monitoring is also discussed as a practice that can improve the efficiency of all types of irrigation methods.

Surface Irrigation

Once initial land grading is completed, surface irrigation is a simple and cheap method for irrigating crops. There is minimal energy cost to operate this type of system. (Table 5.1) This method takes advantage of field slope and gravity to move water across a field, either along strips covering the entire field, or basins that fill the field with water, allowing it to seep into the soil. Surface irrigation alone, without additional runoff control, creates movement of pesticides offsite, and additional costs for some type of runoff control system are necessary. Tail-water return systems are a recommended component of surface irrigation (Burt et. al. 2000) and would reduce the likelihood of pesticide movement offsite. These additional costs are discussed further in the *Drainage Control* section.

Table 5.2 Surface Irrigation - Initial Capital Cost and Recurring Maintenance Costs (from Burt et al. 2000)

System Type	Capital $/acre	Maintenance $/acre/year	Labor hrs/acre	Energy kwh/ac-in
Basin Irrigation	3192	51	0.3	n/a
Border Strip	2228	51	0.4	n/a
Contour Ditch	140	13	2.5	n/a
Continuous Flood	1010	26	0.3	n/a
Furrow	1703	51	1	n/a
Corrugation	1475	51	1.25	n/a

Sprinkler Irrigation

Sprinkler irrigation is more complex and expensive to operate than surface irrigation, but provides for more efficient water use. The major cost involved is the initial capital cost of establishing a basic system composed of a water source, pump, pipe network, sprinklers, and valves. In some systems, labor costs can be high but maintenance costs are relatively low.

Table 5.3 Sprinkler Irrigation - Initial Capital Cost and Recurring Maintenance Costs (from Burt et al. (2000)

System Type	Capital $/acre	Maintenance $/acre/year	Labor hrs/acre	Energy kwh/ac-in
Hand Move Lateral	225	5	0.175	15.4
End Row Lateral	325	10	0.103	15.4
Side Roll Lateral	388	8	0.123	15.4
Traveling Gun	450	27	0.072	43.2
Center Pivot	363	18	0.01	16.5
Center Pivot w/corner	450	27	0.01	17.5
Linear Move w/ditch	488	29	0.021	16.5
Linear Move w/pipe	738	44	0.021	19.5
Portable Solid Set	1200	24	0.103	15.4
Permanent Solid Set	1163	12	0.01	15.4

Micro-irrigation

Micro-irrigation is a broad term covering a number of different systems. The major cost of this method is the initial capital cost of establishing the system. Labor and energy costs are low as the system can be easily operated manually or largely automated.

Table 5.4 Micro-irrigation - Initial Capital and Maintenance Costs (from Burt et al (2000)

System Type	Capital $/acre	Maintenance $/acre/year	Labor hrs/acre	Energy kwh/ac-in
Drip Vineyards	1050	105	0.04	10.95
Drip Orchards Surface	850	85	0.04	10.95
Drip Orchards Subsurface	1100	110	0.04	10.95
Micro Orchards	950	95	0.04	10.95
Drip Row Surface	700	70	0.04	10.95
Drip Row Subsurface	1700	170	0.04	10.95

Sample Cost Comparison of Flood versus Sprinkler Irrigation Systems in Almonds

The University of California Cooperative Extension (UCCE) produces sample cost information for establishment and production of many crops. Cost information is available for almonds grown in the northern San Joaquin Valley, using either flood or sprinkler irrigation. The net cost difference is estimated at $196/acre/year more for sprinkler irrigation than for flood irrigation. This does not account for any cost savings realized by increased irrigation efficiency.

Combining this information with the total number of acres of almonds grown in the project area, the estimated percentage that currently use flood irrigation, and the estimated percentage that use diazinon or chlorpyrifos allows an estimate to be made of the potential cost for conversion of all almond orchards in the project area to sprinkler irrigation. A similar calculation was made for walnuts, using the irrigation costs for almonds as an estimate. The results are provided in Table 5.5.

Table 5.5. Estimated Cost to Convert from Flood to Sprinkler Irrigation

	Almonds		Walnuts	
Total acres in TMDL area	231,788[1]	231,788[1]	28,057[1]	28,057[1]
Estimated percent in flood irrigation	40%[2]	60%[3]	40%[2]	60%[3]
Estimated acres in flood irrigation	92,715	139,073	11,223	16,834
Estimated percentage acres using diazinon or chlorpyrifos	30%[1]	30%[1]	65%[1]	65%[1]
Increased cost/acre for sprinkler irrigation	$196	$196	$196	$196
Total increased cost to convert acres using diazinon or chlorpyrifos to sprinkler irrigation	$5,451,654	$8,177,492	$1,429,810	$2,144.652

1.From 2002 PUR
2 Estimate based on information from USDA 1998 Farm and Ranch Irrigation Survey
3 Estimate based on information from Zoldoske. 2002

Irrigation Practices for Alfalfa

The irrigation and water management practices that are used on alfalfa will be critical for improving water quality for two reasons. Alfalfa accounts for approximately half of the chlorpyrifos used during the irrigation season, and alfalfa consumes more agricultural water (19% DWR estimate) than any other single crop ((Putnam. 2003).

Sprinklers are used for initial establishment of alfalfa fields because the seeds are small and would be washed away by flood irrigation. After establishment, irrigation is usually switched to a flood system when alfalfa is grown on heavy soils, such as in the San Joaquin Valley. Soil type is the most important consideration in determining the best irrigation system to use. The heavy soils, combined with high summertime evapotranspiration rates, necessitate the use of flood irrigation. Sprinklers cannot provide an output high enough to keep up with evapotranspiration. Additionally, because infiltration of water into heavy soils is very slow, once sprinklers have applied the maximum output (2”-3”) it becomes a de facto flood application due to sheeting of water on the surface of the heavy soil. For these reasons, flood irrigation is the predominant method used in the San Joaquin Valley (80 – 90%), and it is unlikely that most growers will switch to another irrigation method. Flood irrigation, if properly managed, can be fairly efficient. One way of improving irrigation management and efficiency is to irrigate based upon the results of soil moisture monitoring. Soil moisture sensors and digital meters are relatively inexpensive (approximately $300), and their use is recommended by UCCE. It is also important for growers to manage their irrigation water efficiently, and not allow unnecessary excess drainage. (Putnam, pers. comm.)

Since options for switching irrigation systems on alfalfa are limited by soil type, other means of controlling runoff will likely be necessary. Some options for controlling runoff include installing tail-water return systems and/or end of field vegetated areas. Costs for these options are explored in the following sections.

Drainage Practices

Proper drainage management can reduce or even eliminate the discharge of pesticides to surface water. Drainage management can be categorized into methods that recirculate surface drainage water and methods that temporarily hold water. These methods include a combination of practices to reuse drainage water (tail-water recovery systems), hold drainage water (berms, water and sediment control basins), and filter drainage water (vegetated drainage ditches, grassed waterways, constructed wetlands).

Surface Drainage Recirculation

Surface drainage recirculation is the recovery of surface drainage water for reuse on irrigated lands. Irrigation systems generate surface runoff to varying degrees depending on application rate, soil type, and other conditions. This method can successfully recover 100% of all surface drainage water for use on the same field or on other fields. Capital costs include earthwork and pumping equipment. Operation and maintenance costs include energy use and labor. (Smith, 2002).

Temporary Retention Ponds

Temporary retention ponds allow for holding of drainage water. Holding drainage water is important to allow sufficient pesticide breakdown prior to release to surface waters. Capital costs include land acquisition, earthwork, and fencing. Other costs can include improved liners and bird netting. Operation and maintenance costs include energy use for pumping and monitoring.

Table 5.6 Drainage Practices Capital and Maintenance Costs

System Type	Capital $/acre	Maintenance $/acre/year	Total $/acre
Surface Drainage Recirculation	812	55	867
Temporary Retention Ponds	340	50	365

Vegetated Buffers
In general terms, vegetated buffers are areas of land located along field edges that are maintained in permanent vegetation. A wide variety of types of vegetated buffers are available, including filter strips, hedgerows, riparian buffers grassy waterways and constructed wetlands. The vegetation and the soil buildup in the buffers slow water movement and increase water infiltration. By slowing its movement, excess irrigation water is more likely to infiltrate into the soil, carrying dissolved pesticides with it. Buffers also reduce the movement of sediment, along with sediment-bound pesticides. Pesticides that infiltrate into the upper soil layer, or that are trapped by vegetation, can be degraded by soil microfauna.

One possible drawback of vegetative buffers is that they may necessitate taking land out of production. Buffers requires maintenance to prevent channelization and accelerated runoff. Concentrated flow of runoff must be prevented, and shallow sheet flow encouraged, so that residence time in the buffer is adequate for pesticide removal. Studies summarized in NRCS (2000) have demonstrated trapping efficiencies of 50 percent or more with properly constructed and maintained buffers.

Costs for vegetated buffers can vary widely, depending on the size of the buffer and the types of vegetation planted. The installation cost of a typical riparian forest buffer with mixed hardwood seedlings and a grass strip is approximately $400 per acre. (NRCS. 2000). Costs for vegetated buffers using only grasses and/or shrubs would be significantly less. Estimated cost of a grassy vegetated buffer is $60/acre (Thomas, F. pers. comm.). Cost-share programs are available through NRCS that can contribute 50 to 75% of the cost of buffer installation.

Setbacks or No Spray Zones
Areas of a field adjacent to aquatic sites may be designated as no spray zones. The cost of this type of practice would be primarily the cost of any lost crop production.

Irrigation Season Pest Management Cost Scenarios

Several scenarios were developed for irrigation season pest management practices, similar to those described in the previous section on dormant season pest management practices. Economic analyses are provided for irrigation season use of chlorpyrifos on almonds and alfalfa. Very little irrigation season use of diazinon occurs. For almonds, four scenarios are described, and three scenarios are described for alfalfa. Each scenario is comprised of a suite of possible pest management practices and cultural practices.

Almonds

The Base Case described for almonds reflects the irrigation regimes currently in use. These regimes are 60% of growers using basin flood irrigation with berms, and 40% of growers using drip irrigation or microsprinklers. The base case assumes one application of chlorpyrifos. No cover crops are used to reduce runoff.

In Scenario 1, orchard sanitation is used, along with Bt application at hull split, instead of chlorpyrifos application. The irrigation regime is the same as in the Base Case.

In Scenario 2, Guthion is used instead of chlorpyrifos because it is the first on the list of chlorpyrifos alternatives listed in the UCIPM guidelines. The irrigation regime is the same as the Base Case. Cover crops are used to reduce runoff.

In Scenario 3, chlorpyrifos is used, but 100% of growers use drip irrigation or microsprinklers to reduce runoff.

Alfalfa

The Base Case described for alfalfa reflects the predominant irrigation regime currently in use. Irrigation is primarily by flooding, without tailwater control or vegetated buffers to reduce runoff. Tailwater control through surface drainage recirculation, and vegetated buffers are both recommended by UCCE for alfalfa, however these practices are not currently in widespread use. The base case assumes one application of chlorpyrifos.

In Scenario 1, pyrethroids are used in lieu of chlorpyrifos. The irrigation regime is flood irrigation as in the Base Case, however tailwater control is used to reduce runoff.

In Scenario 2, pyrethroids are used in lieu of chlorpyrifos. The irrigation regime is flood irrigation as in the Base Case, however a vegetated buffer is used to reduce runoff.

A summary of the results of the economic analyses for almonds and alfalfa is provided in Table 5.7. Detailed cost information is provided in Appendix D.

Table 5.7 Summary of Differences in Irrigation Season Pest Management Costs

	Almond		**Alfalfa**	
	Total cost ($)	Percent Change from Base Case	Total cost ($)	Percent Change from Base Case
Base Case (chlorpyrifos)	$2,781	NA	$1,009	NA
Scenario 1	$2,884	3.7%	$1,124	11.4%
Scenario 2	$2,871	3.2%	$1,084	7.4%
Scenario 3	$2,899	4.2%		
Percent change from Base Case		3.2% to 4.2%		7.4% to 11.4%

5.1.5 Estimated Monitoring, Planning, and Evaluation Costs

Monitoring and planning costs were estimated for two different approaches that orchard growers could take in responding to this Basin Plan Amendment (BPA). Orchard growers could participate in a watershed group to meet the BPA requirements, or orchard growers could work individually with the Regional Board to meet the BPA requirements.

Approximately 1000 growers reported diazinon or chlorpyrifos use annually in the lower San Joaquin River watershed in 2002 and 2003. For purposes of this analysis, it is assumed that all of those growers would need to respond to this BPA. The total cost for monitoring, planning, and evaluation would be approximately $600,000 to $9,500,000 for a waiver-based program, depending on whether growers used a watershed approach or an individual approach, respectively.

Watershed Approach

For a watershed group, the estimated monitoring, planning, and evaluation cost is approximately $600,000 per year, or $600 per grower. It is assumed that monitoring (flow and water quality) would need to be conducted at six sites in the watershed, corresponding to the six compliance sites. Each site would be monitored twelve times during the dormant season and twelve times during the irrigation season. The total monitoring cost would be approximately $76,000 annually. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program. The monitoring cost could be substantially greater if the sample collection were contracted out. The monitoring costs are associated with determining compliance with water quality objectives and load allocations.

The cost for planning and implementation by the watershed group includes development of an annual monitoring and implementation plan, annual reporting of monitoring and implementation results, and coordination of implementation activities. The total cost for these activities is approximately $280,000 annually. The planning and implementation costs are associated with ensuring management practices are implemented, determining the degree of implementation, and reporting on the effectiveness of the implementation efforts in meeting water quality goals.

There is also an assumed cost associated with evaluating effectiveness of management practices. For purposes of this estimate, it is assumed that every farm need not be evaluated, but different practices will need to be evaluated over time. The cost for a project that evaluates the effectiveness of management practices is assumed to be $400,000. It is assumed that one evaluation project would take place every two years. Additionally, it is assumed that annual grower surveys of management practices implemented would be conducted at a cost of $25,000 per year. The total annual cost for effectiveness evaluation is approximately $225,000 per year.

Individual Grower Approach

If growers report directly to the Regional Board, the estimated monitoring, planning, and evaluation cost is about $9,500,000 or $9500 per grower.

It is assumed that monitoring (flow and water quality) would need to take place at 1000 discharge points, one for each grower. Each site would be monitored up to 24 times during the season(s) during which the pesticides are applied or runoff is expected to occur. The total monitoring cost would be approximately $7,000,000 annually. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program. The monitoring cost could be substantially greater if the sample collection and flow monitoring were contracted out instead of conducted by the grower. The monitoring costs are associated with determining compliance with load allocations.

The cost for planning and reporting by the grower would primarily consist of filling out standard forms developed by Regional Board staff for reporting and monitoring purposes. The cost to the grower for his/her time is estimated to be $360 annually.

In addition, a cost is assumed for evaluating the effectives of management practices. It is assumed that such an assessment would be required annually and would cost approximately $2,000 per grower.

5.1.6 Conclusions

The cost of the pesticides typically applied with dormant oil represents a small fraction of total production costs, so substitution of one pesticide for another has little effect on overall costs. If the use of an alternative pesticide increases the likelihood of the need for additional applications of pesticides in the future, then costs increase accordingly because each additional pass over the field generates new costs.

The primary irrigation method used on the major crops to which chlorpyrifos is applied (almonds and alfalfa) is basin flood irrigation. Sprinkler irrigation is also used, although to a lesser degree. If chlorpyrifos continues to be used, or if it is replaced by other pesticides that have a high potential to impair water quality, then irrigation management will be a critical tool to keep pesticide runoff from entering the San Joaquin River at problematic concentrations. Use of more efficient irrigation practices, or installation of drainage controls such as tailwater return systems or vegetated buffers will also be important to the restoration of the beneficial uses of the San Joaquin River. Costs of improved irrigation and drainage practices are relatively greater than the costs of alternative pest management practices.

The cost of monitoring and compliance activities can vary greatly, depending on the approach taken. A watershed group approach would be significantly less costly on a per capita basis, than an individual approach.

The estimated cost of dormant season alternative pest management practices ranges from a minimum cost of approximately $720,000 to a maximum cost of approximately $12 million. The estimated cost of irrigation season alternative pest and water management costs range from $7 million to $9.6 million. The basinwide combined costs of alternative pest management practices, alternative water management practices, and monitoring and compliance activities for the major crops that use diazinon and chlorpyrifos are estimated to range from $8.5 million to $31 million. No adjustments were made for inflation.

5.2 Estimated Regulatory Costs to NPDES Permittees

Retail sales of chlorpyrifos for consumer use ended on December 31, 2001. Retail sales of diazinon for consumer use will end by December 31, 2004. It is therefore anticipated that NPDES permittees will not be required to implement additional management measures or treatment technologies to control diazinon or chlorpyrifos in municipal wastewater treatment plan discharges or in municipal storm water discharge.

Additionally, any diazinon and chlorpyrifos monitoring that is currently part of an NPDES permit is not expected to increase or change as a result of adoption of this BPA. Therefore, no change in control costs or monitoring costs is projected to occur for NPDES permit holders with adoption of this BPA.

5.3 Potential Sources of Financing

In general, the potential sources of funding for agricultural water quality programs do not change significantly by crop type. The sources of funding identified in the Basin Plan for the agricultural subsurface drainage program and rice pesticide program are also potential funding sources for this program. These sources include:

1. Private financing by individual sources.
2. Bonded indebtedness or loans from government institutions.
3. Surcharge on water deliveries to lands contributing to the drainage problem.
4. Ad Valorem tax on lands contributing to the drainage problem.
5. Taxes and fees levied by a district created for the purpose of drainage management.
6. State or federal grants or low-interest loan programs.
7. Single purpose appropriations from federal or state legislative bodies (including land retirement programs).

Specific state and federal grant and loan programs include:

1. USDA Environmental Quality Incentive Program (EQIP) grants, administered by the Natural Resources Conservation Service (NRCS)
2. Proposition 13 Pesticide Research and Investigation of Source, Mitigation (PRISM) grants, administered by the State Water Resources Control Board
3. Consolidated grant program administered by the State Water Resources Control Board, including Proposition 13 Nonpoint Source Pollution (NPS) Control program grants, 319 NPS Implementation Program grants, Proposition 13 CalFed Watershed program grants, Proposition 50 CalFed Watershed Program
4. State Revolving Fund Loan program for NPS pollution

5.4 Economic Analysis Summary

In summary, dischargers of diazinon and chlorpyrifos will incur costs in the implementation of new management practices, and in reporting on compliance with the provisions of the Basin Plan. The actual costs incurred by dischargers will depend on how cost effectively they can minimize or eliminate diazinon and chlorpyrifos runoff. Implementation of new management practices (pest control alternatives to diazinon and chlorpyrifos, and runoff mitigation practices) could result in an aggregate increase in production cost of $720,000 up to $22 million, depending on the pest control and mitigation approaches pursued by growers.

Actual costs will also depend on whether growers report as a group to the Regional Board, which would be the least-cost alternative, or report individually. The costs to dischargers for monitoring, planning, and evaluation are estimated to range from $600,000 total ($600 per discharger) to $9 million ($9,000 per discharger) per year.

Total costs to dischargers for both implementation and reporting could range from $1.3 million to $31 million per year.

6 California Environmental Quality Act (CEQA) Review

This proposed Basin Plan amendment does not prescribe specific changes in land use or pesticide use practices. Therefore, this analysis of potential environmental impacts is based upon an evaluation of the range of possible changes in pest management methods or possible approaches to controlling runoff containing diazinon and chlorpyrifos that could result from adoption of this Basin Plan amendment. This CEQA review is based upon the potential alternative strategies that agricultural users of these pesticides could employ in response to the proposed Basin Plan amendment. Urban uses of diazinon and chlorpyrifos are not considered in detail, since most urban uses of diazinon are being phased out within the time frame for compliance with the proposed Basin Plan amendment, and sales of chlorpyrifos for most urban uses ended in 2000.

6.1 Environmental Checklist Form

6.1.1 Project Title

Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River

6.1.2 Lead Agency Name and Address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

6.1.3 Contact Person and Phone Number

Leslie Grober, Senior Land and Water Use Analyst
(916) 464-4851

6.1.4 Project Location

Lower San Joaquin River from the Airport Way Bridge near Vernalis to the Mendota Dam

6.1.5 Project Sponsor's Name and Address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

6.1.6 General Plan Designation
Not applicable

6.1.7 Zoning
Not applicable

6.1.8 Description of Project
The Regional Board is proposing to amend the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. The purposes of the proposed amendment are to:

- adopt numeric water quality objectives for chlorpyrifos in the SJR from the Airport Way Bridge near Vernalis to the Mendota Dam
- establish maximum loading capacities, load allocations and wasteload allocations for diazinon and chlorpyrifos
- adopt an implementation strategy to bring dischargers of these pesticides into compliance with the new water quality objectives, load allocations and wasteload allocations.

6.1.9 Surrounding Land Uses and Setting
The area impacted by this basin plan amendment is land area that drains into the SJR from the Airport Way Bridge near Vernalis to the Mendota Dam. The land uses in the area include agriculture, urban residential, urban non-residential, open space, and wildlife habitat. Other public agencies whose approval is required include the State Board, OAL, and USEPA.

6.2 Environmental Factors Potentially Affected
Findings: No potentially significant impacts from this proposed action were identified.

______________________________	______________________
Signature	Date
Dennis Westcot, Environmental Program Mgr.	Cal. Regional Water Quality Control Board
Printed Name	Central Valley Region

The environmental resource categories identified below are analyzed herein to determine whether the Proposed Project would result in adverse impacts to any of these resources. None of the categories below are checked because the Proposed Project is not expected to result in "significant or potentially significant impacts" to any of these resources.

☐ Aesthetics	☐ Biological Resources
☐ Hazards & Hazardous Materials	☐ Mineral Resources
☐ Public Services	☐ Utilities/Service Systems
☐ Agriculture Resources	☐ Cultural Resources
☐ Hydrology/Water Quality	☐ Noise
☐ Recreation	☐ Mandatory Findings of Significance
☐ Air Quality	☐ Geology/Soils
☐ Land Use Planning	☐ Transportation/Traffic

On the basis of this initial evaluation:

☒ I find that the Proposed Project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the Proposed Project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the Project have been made by or agreed to by the Project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the Proposed Project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the Proposed Project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect: 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the Proposed Project could have a significant effect on the environment because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the Proposed Project, nothing further is required.

No potentially significant impacts from this proposed action were identified.

______________________________	______________________
Signature	Date
Dennis Westcot, Environmental Program Mgr.	Cal. Regional Water Quality Control Board
Printed Name	Central Valley Region

6.3 Evaluation of Environmental Impacts

This Environmental Checklist has been prepared in compliance with the requirements of CEQA relating to certified regulatory programs.

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
I. AESTHETICS – Would the Project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒
II. AGRICULTURE RESOURCES – In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the Project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒
III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control the District may be relied upon to make the following determinations. Would the Project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
IV. BIOLOGICAL RESOURCES – Would the Project:				
a) Have a substantial adverse effect, either directly, or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulators, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
V. CULTURAL RESOURCES – Would the Project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource of site or unique geological feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
VI. GEOLOGY AND SOILS – Would the Project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
Iii) Seismic-related ground failure,, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
VII. HAZARDS AND HAZARDOUS MATERIALS – Would the Project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
f) For a Project within the vicinity of a private airstrip, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒
VIII. HYDROLOGY AND WATER QUALITY – Would the Project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which results in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding,	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
including flooding as a result of the failure of a levee or dam?				
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. LAND USE AND PLANNING – Would the Project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒
X. MINERAL RESOURCES – Would the Project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒
XI. NOISE – Would the Project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒
f) For a Project within the vicinity of a private airstrip, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒
XII. POPULATION AND HOUSING – Would the Project:				
a) Induce substantial population growth in an	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
XIII. PUBLIC SERVICES				
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒
XIV. RECREATION				
a) Would the Project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
XV. TRANSPORTATION/TRAFFIC – Would the Project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio to roads, or congestion at intersections?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion/management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns,	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
including either an increase in traffic levels or a change in location that results in substantial safety risks?				
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS – Would the Project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which serves or may serve the Project that it has adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒
XVII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the Project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number of restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
b) Does the Project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probably future projects)?	☐	☐	☐	☒
c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

6.3.1 Thresholds of Significance
For the purpose of making impact determinations, potential impacts were determined to be significant if the proposed Basin Plan amendment or its alternatives would result in changes in environmental condition that would, either directly or indirectly, cause a substantial loss of habitat or substantial degradation of water quality or other resources.

6.4 Discussion of Environmental Impacts
The analysis of potential environmental impacts is based upon the possible changes in pest management methods or possible approaches to controlling runoff of diazinon and chlorpyrifos in response to the proposed Basin Plan amendment. The evaluation is based on the alternative strategies described in Section 4.4 of this report.

6.4.1 Aesthetics
The proposed Basin Plan amendment will likely result in changes in pest management practices on orchard crops and certain field crops. Potential practices are described in Section 4.4 and Appendix B. None of those practices would alter any scenic vistas, damage scenic resources, degrade the visual character of any site, or adversely affect day or nighttime views.

6.4.2 Agricultural Resources
The practices discussed in Section 4.4 and Appendix B, or other potential strategies that could be pursued by growers, are unlikely to lead to a conversion of agricultural land to other uses. Conservation buffers, which may be installed to reduce runoff containing pesticides, are considered to be agricultural land.

Regional Board staff has reviewed the potential range of costs of the proposed implementation program, as well as the potential range of costs of alternative pest management strategies and water management practices that might be employed by growers. This review has shown that growers have a wide range of alternatives to diazinon and chlorpyrifos available to both maintain control of pests and to minimize or eliminate water quality impacts. Based on the wide range of options available, growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming and meet water quality objectives and load allocations.

The review has also shown the availability of alternative irrigation methods that could be implemented to reduce diazinon and chlorpyrifos in irrigation runoff. As with alternative pest control methods, there is a range of irrigation options available, and growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming and meet water quality objectives.

The availability of federal and state government funds for environmental conservation (e.g. EQIP, Proposition 13 and other funds) should allow growers to offset some of their costs, if they choose an approach that requires a large capital investment.

6.4.3 Air Quality

Implementation of some of the alternative pest management strategies and pesticide application technologies, especially those that result in a reduction in diazinon and chlorpyrifos use rates, could lead to a reduction in aerial drift, and therefore an improvement in air quality.

Some of the alternative pest management practices could lead growers to switch from diazinon and chlorpyrifos to other pesticides. In response to a Regional Board request, the DPR has evaluated those alternative pesticides to determine whether air quality could be impacted by use of the alternatives. It is DPR's opinion that a reduction in the use of diazinon and chlorpyrifos in the San Joaquin Valley would result in an improvement in air quality, even if an increase in the use of alternative pesticides, such as carbaryl or pyrethroids, occurs (R. Segawa, pers. comm.).

Under the Toxic Air Contaminant Program, DPR prioritizes pesticides for air monitoring based on human toxicity, use patterns, and volatility. The DPR and the California Air Resources Board (ARB) monitor for a number of pesticides in the San Joaquin Valley. In addition to the Toxic Air Contaminant Program, DPR tracks emissions of volatile organic compounds (VOCs) from pesticide products because they are precursors to ozone. It is unlikely that changes in use patterns due to regulatory action on diazinon and chlorpyrifos will cause DPR's goals for reduction of VOC emissions from pesticides to be exceeded (R. Segawa, pers. comm.).

Changes to water management practices should result in improved water conservation. This will not have any affect on air quality.

6.4.4 Biological Resources

The proposed Basin Plan amendment is designed to reduce diazinon and chlorpyrifos in runoff to levels that are not toxic to organisms in the SJR. Therefore, effects of this amendment on biological communities should be positive. As described in Section 4.4 and Appendix B, growers also currently use other pesticides, including pyrethroid and carbamate insecticides that, when present in runoff or in aquatic sediments, could have an effect on biological resources. These insecticides are commonly used on a variety of crops and under a wide range of conditions. Growers who currently use diazinon and chlorpyrifos may choose to switch to these or to other products to control pests in response to this Basin Plan amendment, causing a further increase in their use.

In order to prevent the substitution of other potential biologically damaging pesticides for diazinon and chlorpyrifos, this amendment includes monitoring requirements that will allow the

Regional Board to identify potential impacts of pesticides in orchard runoff. The amendment also requires agricultural pesticide dischargers to implement control measures to insure compliance with water quality objectives, when alternatives to diazinon and chlorpyrifos have the potential to contaminate surface water or groundwater. The Basin Plan currently contains water quality objectives that do not allow pesticides to impact beneficial uses, including aquatic life use. This amendment does not change in any way, the applicability of these objectives.

Changes to water management practices should result in improved water conservation. This should not have any negative effect on biological resources.

6.4.5 Cultural Resources

Implementation of the proposed Basin Plan amendment is unlikely to affect cultural resources. None of the potential practices that growers might implement are likely to change the significance of any historical or archaeological resource, destroy a unique paleontological resource or geologic feature, or disturb any human remains.

6.4.6 Geology and Soils

Implementation of the Basin Plan amendment will not affect the geology of the region and will not expose people to additional geologic hazards. As discussed in Appendix B, growers may plant cover crops or buffer strips to increase soil infiltration and reduce runoff, which will likely reduce soil erosion. Changes to water management practices should result in improved water conservation, and will not result in increased erosion or siltation.

6.4.7 Hazards and Hazardous Materials

The DPR examines hazards posed by pesticides to workers and the public during its regulatory process. Each product is evaluated for potential hazards, and any conditions necessary for the safe use of the material are required on the label or in specific regulations. Some of these requirements include use of protective clothing and respirators, use of a closed system for mixing and loading, or special training requirements for workers applying the pesticide.

Some of the pesticides discussed in Appendix B as alternatives to diazinon and chlorpyrifos, such as azinphos methyl, methidathion, and carbaryl, are restricted use pesticides. Restricted use pesticides require permits to purchase and apply, and usually require special handling procedures. Propargite is on DPR's Minimal Exposure Pesticide list, and requires special protection for workers due to its toxicity. Implementation of this Basin Plan amendment should not result in any increased exposure to hazards or hazardous material.

6.4.8 Hydrology and Water Quality

None of the potential options to reduce diazinon and chlorpyrifos in runoff are likely to result in changes in drainage patterns that would increase erosion or siltation, increase the rate or amount of surface runoff, increase the risk of flooding, contribute to increases in storm water runoff that would exceed the capacity of stormwater drainage systems, or increase the chance of inundation by seiche, tsunami, or mudflow.

One of the approaches to reducing diazinon and chlorpyrifos in runoff discussed in Section 4.4 and Appendix B is to increase the infiltration of stormwater into soil, rather than allowing it to run off the end of the orchard or field. Increasing infiltration is not likely to result in groundwater contamination with pesticides, especially in soils with moderate to high clay and organic matter content. Pyrethroids, and some of the other pesticides discussed in Appendix B, have very high soil adsorption coefficients that cause them to bind tightly to soils, and therefore these pesticides would not be carried more than a few inches below the soil surface. Other pesticides breakdown quickly through microbial decomposition and therefore do not persist long enough to be carried to groundwater.

The amendment includes a policy that requires growers to evaluate whether an alternative pesticide could potentially result in ground water contamination or violation of surface water quality objectives. The policy states that growers should use an alternative that will not result in groundwater contamination or violation of surface water quality objectives.

Changes to water management practices should result in improved water conservation. This will not have any negative effect on hydrology and water quality.

6.4.9 Land Use and Planning
Implementation of the proposed Basin Plan amendment should not result in any changes in land use or planning. See discussion of Agricultural Resources above.

6.4.10 Mineral Resources
The effect of the proposed Basin Plan amendment should be limited to land currently under agricultural production, and there should be no impact to mineral resources.

6.4.11 Noise
The proposed Basin Plan amendment could lead to changes in the way in which diazinon and chlorpyrifos are applied. The alternative practices (see Section 4.4 and Appendix B) should not lead to any increase in exposure to noise. The proposed Basin Plan amendment should have no impact on noise in the project area.

6.4.12 Population and Housing
The proposed Basin Plan amendment will likely result in changes in pest management practices on orchards and certain field crops. Those changes in pest management practices would not directly or indirectly induce population growth in the area, displace existing housing, or displace people. The proposed Basin Plan amendment should not have an impact on population and housing.

6.4.13 Public Services
The proposed Basin Plan amendment will not have an impact on public services. If the implementation program for the Basin Plan amendment is administered at the county level, CACs may need to add as many as two additional staff, depending on the county. These potential staff increases should not require new or altered government facilities.

6.4.14 Recreation
There should be no increase in use of parks or recreational facilities or the need for new or expanded recreational facilities as a result of this proposed Basin Plan amendment.

6.4.15 Transportation/Traffic
The proposed Basin Plan amendment will not have an impact on transportation/traffic. None of the potential alternative practices (see Section 4.4 and Appendix B) should result in changes in traffic or require changes in traffic infrastructure.

6.4.16 Utilities and Service Systems
The proposed Basin Plan amendment will likely result in changes in pest management practices on orchards and some field crops. No wastewater treatment requirements for diazinon and chlorpyrifos in agricultural runoff have been established by the Regional Boards. No wastewater treatment requirements have been established for diazinon and chlorpyrifos from other potential sources, such as urban runoff or municipal treatment plants in the project area, due to the phase out of the use of these pesticides in urban settings. The proposed Basin Plan amendment should not result in changes in wastewater treatment requirements.

None of the potential alternative practices (Section 4.4 and Appendix B) would cause the construction of new water or wastewater treatment plants or the expansion of existing plants for control of diazinon and chlorpyrifos in runoff from agricultural fields. The phase-out of the residential use of diazinon and chlorpyrifos makes it highly unlikely that these pesticides would be present in the effluent of municipal wastewater treatment plants at levels requiring additional wastewater treatment controls.

The proposed Basin Plan amendment does not require and should not result in the construction or expansion of new storm water drainage facilities. The most feasible practices for the control of diazinon and chlorpyrifos in agricultural runoff are changes in on-field practices, including changes in pest management and water management practices. It is unlikely that alterations in storm drainage facilities would be an effective means of reducing diazinon and chlorpyrifos in runoff from agricultural areas.

The proposed Basin Plan amendment should not result in significant changes in water supply. One of the potential alternative practices that could be used by growers would be the use of cover crops to increase infiltration and reduce surface runoff of water, which may contain diazinon, chlorpyrifos and other contaminants. The use of cover crops may or may not require additional irrigation water, but it should also result in reduced evaporation from soil surfaces, with little net change in irrigation water needs. Changes to water management practices should result in improved water conservation.

The proposed Basin Plan amendment should not require any changes in wastewater treatment services. The potential practices that could be applied by growers (see Section 4.4 and Appendix B) should not result in any changes in the generation of solid waste and therefore should not impact landfill capacity. The potential practices that could be applied by growers (see Section 4.4 and Appendix B) should not result in any changes in the generation of solid waste and therefore should not affect compliance with federal, state, or local statutes and regulations related to solid waste.

6.4.17 Mandatory Findings of Significance

The Basin Plan amendment is designed to reduce diazinon and chlorpyrifos concentrations in the lower SJR, and to ensure that increased use of the alternatives to these pesticides will not degrade water quality. The water quality objectives established by this amendment are designed to eliminate the impacts of diazinon and chlorpyrifos to aquatic life in the lower SJR. This Basin Plan amendment does not require or allow any changes in pesticide application practices that could degrade the quality of the environment or have environmental effects that could cause substantial indirect or direct adverse effects on human beings.

The proposed Basin Plan amendment will likely result in changes in pest management and water management practices on orchards and on some field crops. Growers may use other pesticides instead of diazinon and chlorpyrifos, and they may apply pesticides less frequently. The Regional Board's Basin Plan amendment, therefore, addresses the identified water quality impacts from diazinon and chlorpyrifos in runoff, as well as the potential impact of other pesticides applied to orchards and fields.

There are no probable future changes in Regional Board programs that would lead to cumulatively significant impacts when combined with likely impacts from the proposed Basin Plan amendment.

7 Public Participation and Agency Consultation

Regional Board staff held public workshops to inform the public and interested parties of the status and staff progress on the diazinon and chlorpyrifos TMDL. The workshops included the initial outreach to inform the stakeholders that this TMDL was beginning, and continuous updates were conducted when each draft component of the SJR Chlorpyrifos and Diazinon TMDL Report was completed. These workshops were held to seek public input during TMDL development (Table 7.1). Additional outreach presentations were made to San Joaquin River Agricultural Implementation Group (AIG), and to the Merced and Stanislaus county pest control advisors and pest control applicators. Staff workshops were held on 23 July and 10 September 2002 where members of the public were given the opportunity to discuss the draft TMDL report and the Implementation Framework with Regional Board staff.

Table 7.1 Summary of Public Workshops

Date	Workshop
August 2000	Initial Outreach of OP Pesticide TMDL
November 2000	Initial Stage of the TMDL Development / Draft Problem Statement
January 2001	Introduced Elements of TMDL and Monitoring Data
June 2001	Draft Numeric Target Report
March 2002	Draft Source Analysis Report
July 2002	Draft TMDL Report
September 2002	Draft TMDL Implementation Framework

Additional workshops are planned during the Basin Planning phase. The Regional Board will consider adoption of the proposed Basin Plan amendment during a public hearing.

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